SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-45

Name: Angostura Reservoir **County:** Fall River

Legal description: T 8S, R 5,6 E Sec. 1-12,17,19, 20, 21, 28-33
Location from nearest town: 7 miles southeast of Hot Springs, SD.
Dates of present survey: May 14-16, August 9, 22-24, 2012
Date last surveyed: May 16-18, August 8-11, 2011
Management classification: Warmwater permanent

Primary Species: (game and forage)	Secondary and other species:
1. Walleye	1. Bluegill
2. Channel Catfish	2. Common Carp
3. Smallmouth Bass	3. Green Sunfish
4. Gizzard Shad	4. Northern Pike
5. Largemouth Bass	5. Northern Redhorse
6. Black Crappie	6. River Carpsucker
7. Spottail Shiner	7. White Sucker
8. Emerald Shiner	8. Yellow Perch
9.	9. Freshwater Drum

PHYSICAL CHARACTERISTICS

Surface Area: 4,612 acres; **Watershed:** 5,824,000 acres
Maximum depth: 70 feet; **Mean depth:** 29.3 feet
Lake elevation at survey (from known benchmark): unknown

Ownership of lake and adjacent lakeshore property:

The U.S. Bureau of Reclamation performs the maintenance of Angostura Reservoir and Dam. The South Dakota Department of Game, Fish and Parks manages much of the adjacent land as recreation/campground area and as a Game Production Area. The local irrigation district controls the water level and irrigation releases.

Fishing Access

Angostura Reservoir has excellent access for boat and shore anglers. Seven boat ramps are located around the reservoir and a marina with store is located at the northeast corner of the lake. Shore anglers can access around the reservoir by paved roads and on the southern portion through two track trails. A state park sticker is required for all public access to the reservoir.

Observations of Water Quality and Aquatic Vegetation

Department personnel identified no pollution problems during the 2012 survey. Submergent vegetation, curlyleaf pondweed and sago pondweed were observed in the bays and shallow water areas of Angostura. Emergent vegetation consisted of cattail and smartweed.

Observations on conditions of structures (i.e. spillway, boat ramps and docks, roads, etc)

No apparent problems were identified on either the dam or spillway. The boat ramps and other facilities were in excellent condition.

MANAGEMENT OBJECTIVES

Objective 1. To maintain a Walleye fishery with a minimum gill net catch for stock-length (15 in) and longer of 20 per net, a PSD range of 30-60, PSD-P 10 or greater, and maintain a mean growth rate of no less than 35.5 cm (14 in) by age-3.

Objective 2. Maintain the Gizzard Shad population.

Objective 3. Maintain an angler satisfaction rate of 64.5% or greater.

BIOLOGICAL DATA

Daytime boat electrofishing, modified fyke (trap) nets consisting of a 1.3 X 1.5 m frame, 19.1 mm (0.75 in) mesh and a 1.2 X 23 m (3.9 X 75.5 ft) lead and experimental gill nets (45.7 m [150 ft] long and 1.8 m [6 ft] deep with six 7.6 m [25 ft] panels of bar mesh sizes: 12.7 mm [0.5 in], 19.1 mm [0.75 in], mm [1.25 in], 38.1 mm [1.5 in], and 50.8 mm [2.0 in]), were used to accomplish fish surveys at Angostura Reservoir. Daytime electrofishing was completed on August 9, 2012 to index Gizzard Shad reproduction. Sampling consisted of ten stations totaling 1.14 hours of electrofishing. Daytime electrofishing is further discussed in the Gizzard Shad portion of this report. Trap nets were used on May 14-16 and experimental gill nets on August 22-24, 2012 to index adult fish populations in the reservoir (Figure 1). The net sampling consisted of eight trap net nights and four gill net nights and catch data is displayed in Tables 1 and 2. Discussion on selected fish species follows and completes this report.

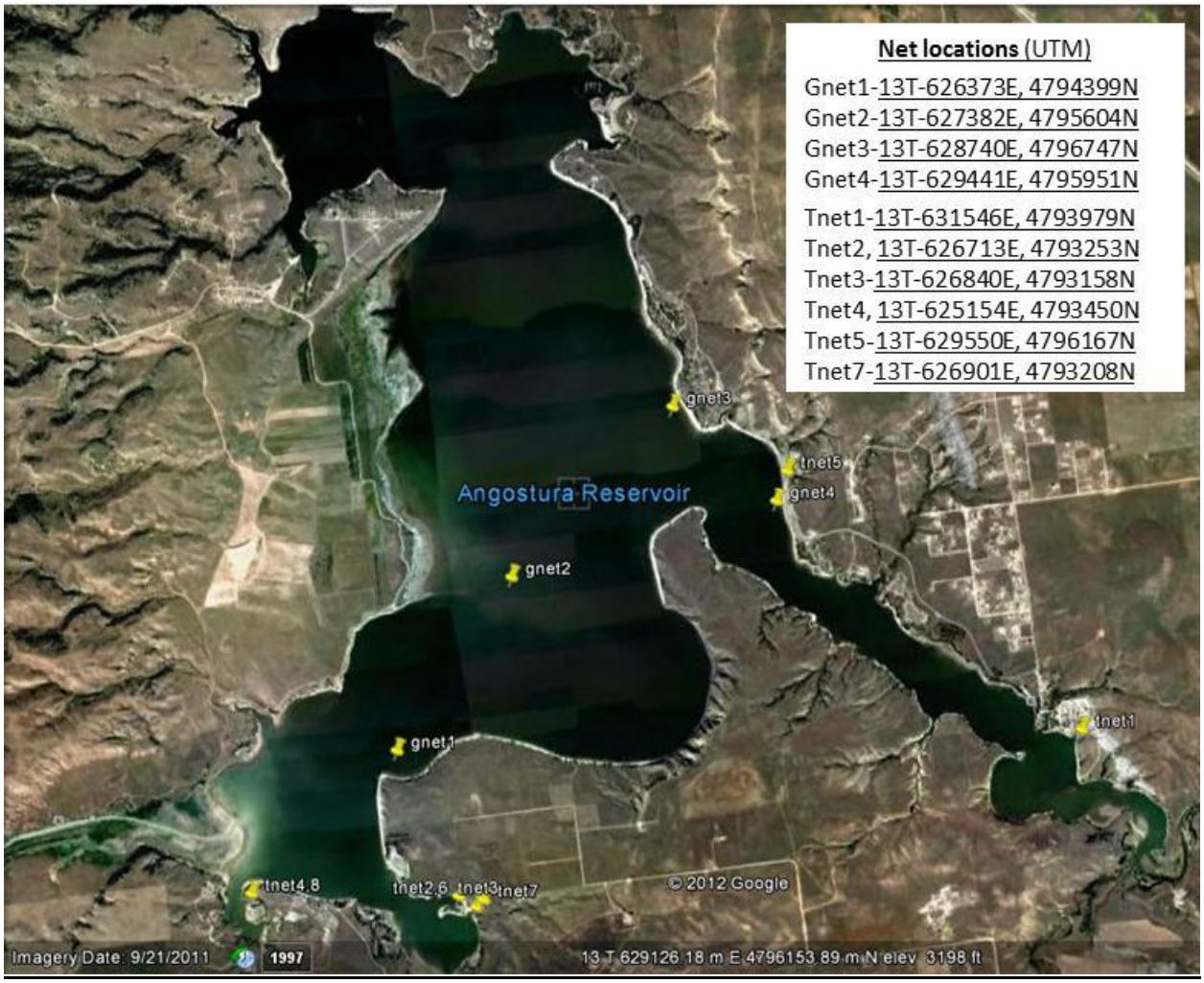

Figure 1. Locations, including GPS coordinates, of experimental gill (gnet) and modified fyke (tnet) nets during the fisheries survey of Angostura Reservoir, Fall River County, South Dakota, 2012.

Table 1. Species, number captured (N), catch per unit effort (CPUE), catch per unit effort of stock-length fish (CPUE-S), proportional stock density (PSD) , proportional stock density of preferred-length fish (PSD-P)and relative weight of stock length or greater fish (*Wr*>S) from all species collected in modified fyke nets in Angostura Reservoir, Fall River County, South Dakota, May 14-16, 2012. CPUE values with 80% confidence intervals in parentheses. PSD, PSD-P and *Wr*>S values with 90% confidence intervals in parentheses.

Species	N	CPUE	CPUE-S	PSD	PSD-P	*Wr*>S
Black Crappie	32	4.0 (2.0)	4.0 (2.0)	94 (8)	31 (14)	94.7 (1.1)
Bluegill	36	4.5 (1.7)	4.5 (1.7)	83 (11)	0	108.7 (1.1)
Green Sunfish	1	0.1 (0.2)	0.1 (0.2)	--	--	76.1 (--)
Northern Pike	1	0.1 (0.2)	0.1 (0.2)	--	--	--
River Carpsucker	1	0.1 (0.2)	0.1 (0.2)	--	--	--
Shorthead Redhorse	1	0.1 (0.2)	0.1 (0.2)	--	--	103.3 (--)
Smallmouth Bass	4	0.5 (0.7)	0.5 (0.7)	--	--	92.3 (3.2)
Walleye	6	0.8 (0.6)	0.8 (0.6)	--	--	89.8 (6.2)
Totals	82					

Table 2. Species, number captured (N), catch per unit effort (CPUE), catch per unit effort of stock-length fish (CPUE-S), proportional stock density (PSD) , proportional stock density of preferred-length fish (PSD-P)and relative weight of stock length and greater fish (*Wr*>S) from all species collected in experimental gill nets in Angostura Reservoir, Fall River County, South Dakota, August 22-23, 2012. CPUE values with 80% confidence intervals in parentheses. PSD, PSD-P and *Wr*>S values with 90% confidence intervals in parentheses.

Species	N	CPUE	CPUE-S	PSD	PSD-P	*Wr*>S
Black Crappie	4	1.0 (1.2)	0.8 (0.8)	--	--	--
Bluegill	1	0.3 (0.4)	0.3 (0.4)	--	--	104.6 (--)
Channel Catfish	65	16.3 (8.0)	9.8 (5.4)	13 (9)	0	82.9 (1.1)
Common Carp	24	6.0 (3.9)	6.0 (3.9)	25 (15)	8 (10)	83.8 (0.4)
Freshwater Drum	18	4.5 (1.1)	1.8 (1.2)	43 (39)	14 (28)	83.5 (6.6)
Gizzard Shad	5	1.3 (1.0)	0.3 (0.4)	--	--	104.9 (--)
Northern Pike	2	0.5 (0.5)	0.5 (0.5)	--	--	89.1 (31.3)
River Carpsucker	14	3.5 (5.2)	3.5 (5.2)	93 (13)	71 (23)	93.7 (3.2)
Shorthead Redhorse	6	1.5 (1.4)	1.5 (1.4)	--	--	95.0 (21.9)
Smallmouth Bass	52	13.0 (10.7)	12.8 (10.9)	39 (12)	8 (7)	97.9 (1.2)
Spottail Shiner	2	0.5 (0.5)	0.5 (0.5)	--	--	--
Walleye	86	21.5 (9.1)	20.0 (8.1)	48 (10)	6 (5)	87.7 (0.8)
Yellow Perch	11	2.8 (1.8)	2.8 (1.8)	18 (22)	9 (17)	90.7 (1.9)
Totals	290					

Black Crappie

Last year, trap net catch per unit effort (CPUE) was 26.4 per net (Table 3). Size structure showed a population dominated by large fish with a proportional stock density of quality-length (PSD) of 100 and of preferred-length (PSD-P) of 50. This year water levels were much lower and may have affected catch rates as average declined to 4.0. Size structure was similar to

2011, with a PSD of 94 and a PSD-P of 31. Fish condition was good with a mean relative weight for stock length and larger fish (*Wr*>S) of 94.7 (Table 1). The length frequency histogram shows very few fish under quality length (Figure 2).

Table 3 Year, number collected (N), catch per unit effort (CPUE) and proportional stock density (PSD) and proportional stock density of preferred-length fish (PSD-P) for Black Crappie collected in modified fyke nets in Angostura Reservoir, Fall River County, South Dakota, 2006-2012. CPUE's with 80% confidence intervals in parentheses. PSD and PSD-P values with 90% confidence intervals in parentheses.

Year	N	CPUE	PSD	PSD-P
2006	40	5.0 (1.9)	19 (12)	6 (8)
2007	23	2.9 (0.9)	39 (20)	11 (13)
2008	93	11.6 (3.8)	43 (9)	9 (6)
2009	58	7.3 (2.4)	65 (12)	14 (9)
2010	32	4.0 (1.9)	61 (18)	22 (15)
2011*	211	26.4 (15.4)	100 (1)	50 (6)
2012*	32	4.0 (2.0)	94 (8)	31 (14)

*spring sample

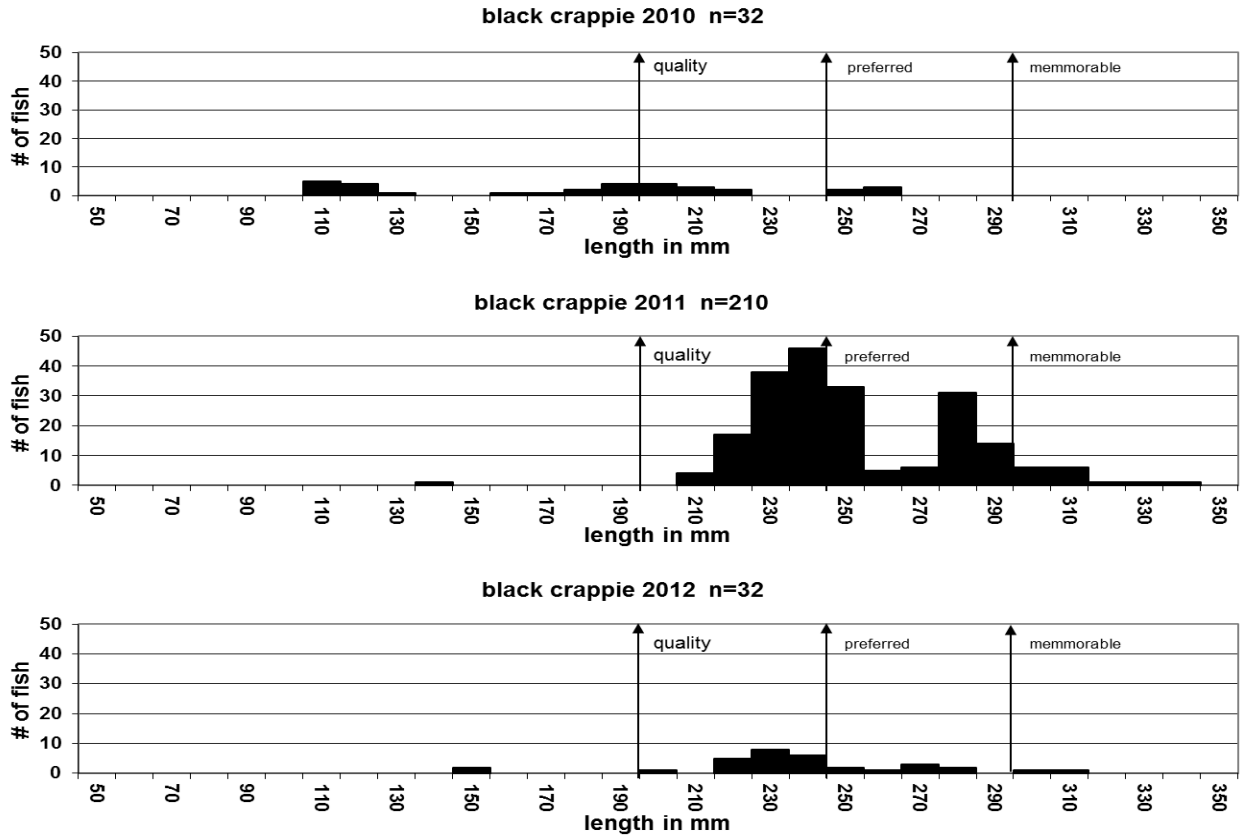

Figure 2. Length frequency histograms of Black Crappies collected by modified fyke nets from Angostura Reservoir, Fall River County, 2010-2012.

Bluegill

Bluegill catch was low in 2012 with a CPUE of 4.5 (Tables 2 and 4). Stock density indices indicate good size structure with a PSD of 83, but no preferred length fish were sampled. The length frequency histogram indicates these fish have grown roughly 30 mm since 2010 (Figure 3).

Table 4. Year, number collected (N), catch per unit effort (CPUE) and proportional stock density (PSD) and proportional stock density of preferred-length fish (PSD-P) for Bluegill collected by trap nets in Angostura Reservoir, Fall River County, South Dakota, 2006-2012. CPUE's with 80% confidence intervals in parentheses. PSD, PSD-P with 90% confidence intervals in parentheses.

Year	N	CPUE	PSD	PSD-P
2007	17	2.1 (1.6)	53 (22)	0
2008	152	19.0 (8.3)	3 (3)	0
2009	130	16.3 (5.7)	15 (6)	0
2010	47	5.9 (3.7)	43 (13)	0
2011*	6	0.8 (0.7)	67 (43)	0
2012*	36	4.5 (1.7)	83 (11)	0

*spring sample

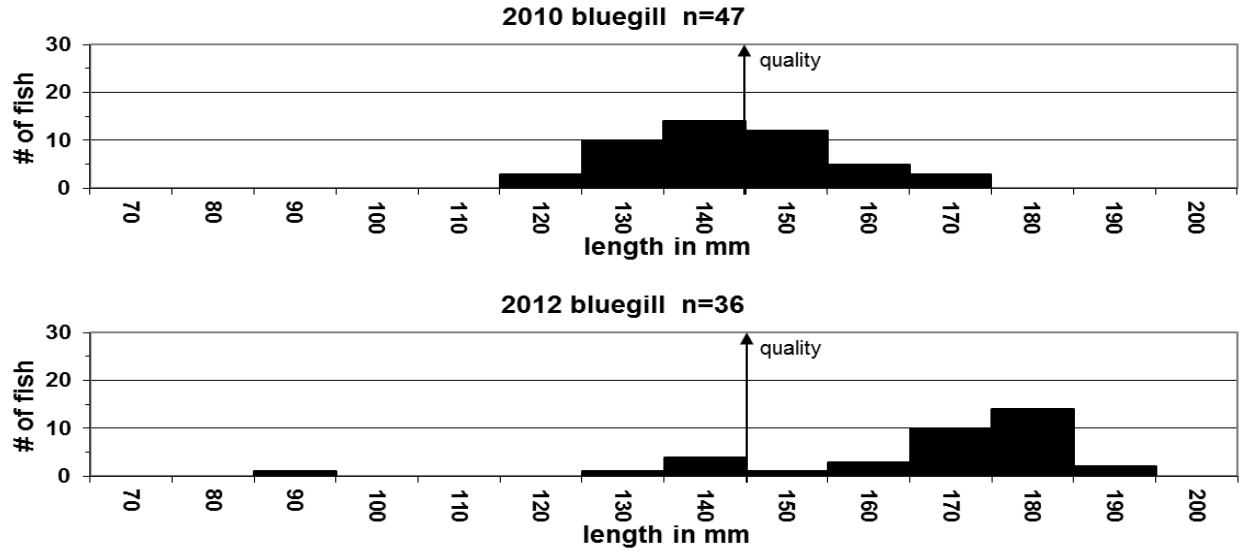

Figure 3. Length frequency histograms of Bluegill collected from Angostura Reservoir, Fall River County, South Dakota, 2010 and 2012.

Channel Catfish

Channel Catfish were the second most abundant fish collected in gill nets (Table 2). Mean gill net CPUE for Channel Catfish was 16.3, and for fish stock length and greater CPUE was 9.8, which is much lower than last year (Table 5). Stock density indices remain low; PSD=13, PSD-P=0. Mean Channel Catfish *Wr>S* was also low at 82.9. The length frequency histogram (Figure 4) is similar to last year with few fish over 400 mm. There appears to be a large year class or two between 310-370 mm, which has moved very little over the past five years.

Table 5. Year, number collected (N), catch per unit effort (CPUE), catch per unit effort of stock-length fish (CPUE-S), proportional stock density (PSD) and proportional stock density of preferred-length fish (PSD-P) for Channel Catfish collected by experimental gill nets in Angostura Reservoir, Fall River County, South Dakota, 2006-2012. CPUE's with 80% confidence intervals in parentheses. PSD, PSD-P with 90% confidence intervals in parentheses.

Year	N	CPUE	CPUE-S	PSD	PSD-P
2006	170	42.5 (12.3)	14.3 (4.2)	5 (5)	0
2007	138	34.5 (7.5)	10.0 (4.6)	10 (8)	3 (4)
2008	99	33.0 (8.5)	19.0 (10.4)	5 (5)	0
2009	137	34.3 (16.7)	26.5 (11.4)	2 (2)	0
2010	60	15.0 (5.3)	13.8 (5.1)	11 (7)	0
2011	120	30.0 (4.6)	24.0 (2.9)	21 (7)	0
2012	65	16.3 (8.0)	9.8 (5.4)	13 (9)	0

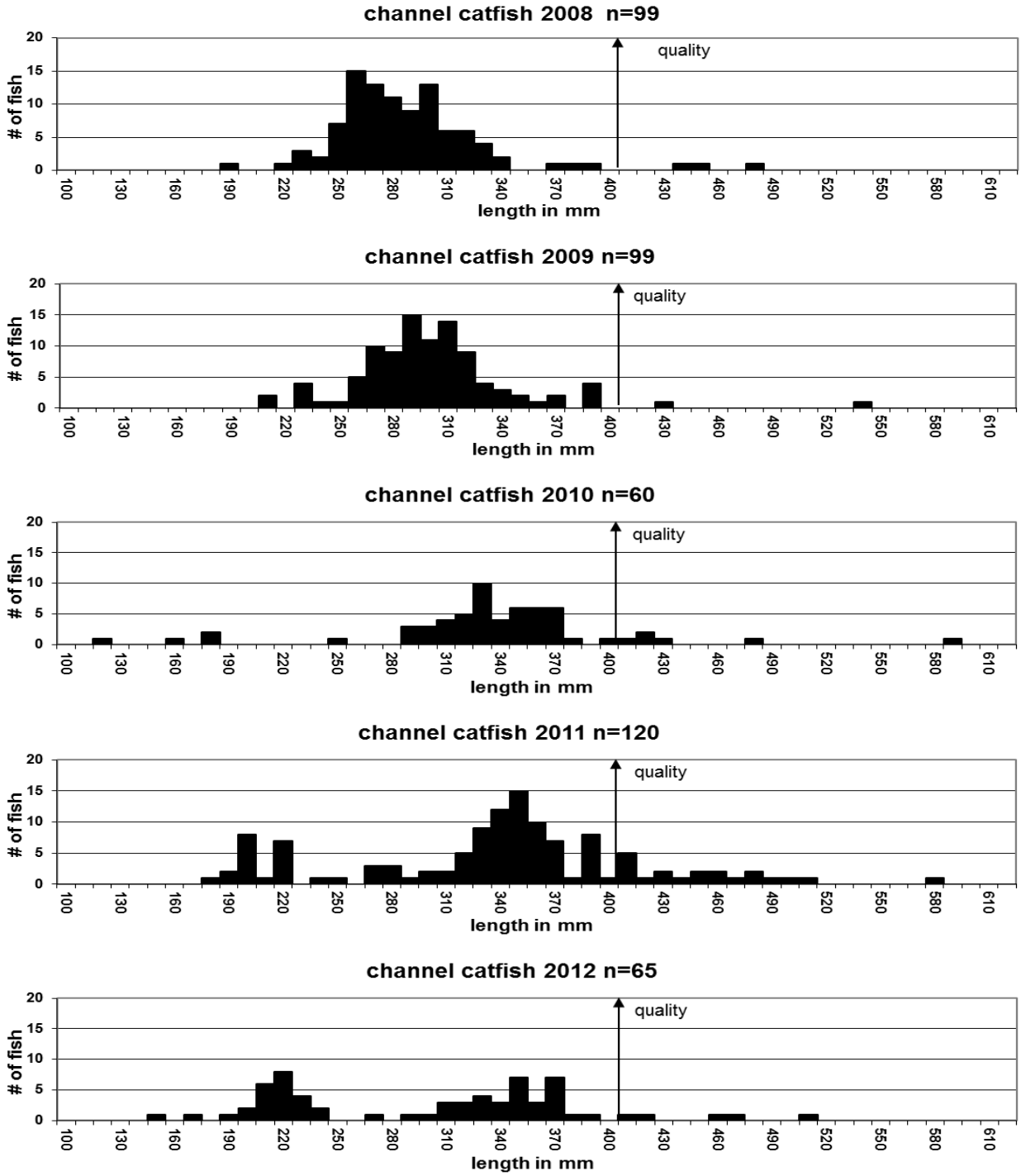

Figure 4. Length frequency histograms of Channel Catfish collected in experimental gill nets from Angostura Reservoir, Fall River County, South Dakota, 2008-2012.

Gizzard Shad

Gizzard Shad were first introduced to Angostura Reservoir in 1990 to provide additional forage for game fish, particularly Walleye, which were experiencing slow growth, low *Wr*'s and high mortality. The first age-0 Gizzard shad were collected in 1994 during a ¼ arc seine survey, indicating natural reproduction. As a result, no adult Gizzard Shad have been stocked in Angostura Reservoir since 1994.

Daytime boat electrofishing was completed during August 9, 2012 and a total of 365 age-0 Gizzard Shad were captured in 1.14 hours of electrofishing (Table 6). Catch per hour was 320.2 per hour compared to 179.5 last year, with six of ten sites sampled containing Gizzard Shad, possibly indicating increased reproduction from 2011 (Table 6 and Figure 5).

The northern latitude of South Dakota and subsequent cold winter water temperatures likely causes some over-winter mortality of Gizzard Shad on an annual basis. Limited winter mortality of Gizzard Shad is desirable to keep densities of adults low, while maintaining high reproductive potential do to the high fecundity of the species. Due to the continued presence of age-0 Gizzard Shad and adults, it is apparent that some survival is occurring and large year classes of juveniles can be produced by a limited number of adults.

Table 6. Site number, number captured at each site (No./Site), time in seconds and number captured per hour (No./hr) during daytime boat electrofishing of age-0 Gizzard Shad from Angostura Reservoir, Fall River County, South Dakota, August 9, 2012.

Site	No./Site	Time (sec)	No./hr
1	0	494	0
2	0	600	0
3	2	300	24
4	1	300	12
5	124	300	1488
6	186	300	2232
7	22	300	264
8	0	600	0
9	0	600	0
10	30	300	360
Total	365	1.14hr	320.2

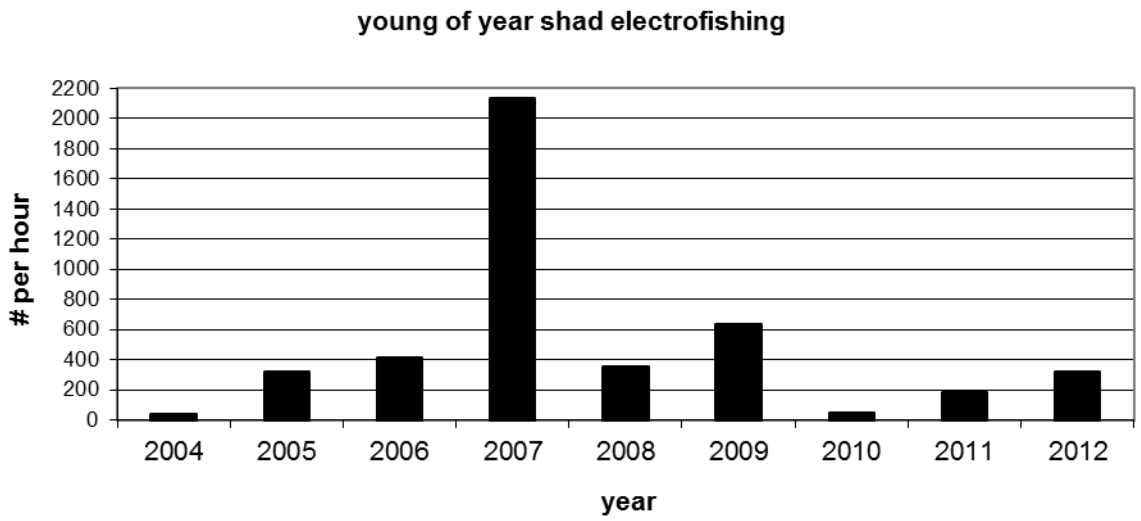

Figure 5. Daytime electrofishing results for young of year Gizzard Shad from Angostura Reservoir, 2004-2012.

Walleye

Angostura Reservoir remains a popular Walleye fishery in western South Dakota. Despite high fishing pressure, Walleye abundance remains good with a gill net CPUE of 21.5 (Table 7). In 2011, CPUE was a little lower at 17.8. CPUE for stock length and larger fish (CPUE-S) was 20.0 in 2012, in comparison to 16.5 in 2011. The 2005 lake management plan sets the target CPUE for stock length and longer walleye to be at least 20 per gill net, which is right about where it is at most years.

Stock density indices indicate a lower proportion of quality Walleye in comparison to 2011, with a PSD of 48. The current management objective is PSD between 30 and 60. Fish over twenty inches decreased slightly with this survey yielding a PSD-P of 6, compared to 9 last year. Walleye condition was up slightly from a mean *Wr*>S 84.8 in 2011 to 87.7 in 2012 (Table 7). Condition and stock density indices have remained stable over the last five years. Growth continues to look excellent with fish surpassing 15 inches between age-2 and age-3 (Table 8). The length frequency histogram resembles a balanced population with several strong year classes present (Figure 6).

Table 7. Year, number captured (N), catch per unit effort (CPUE), catch per net night of stock-length fish (CPUE-S), proportional stock density (PSD) and proportional stock density of preferred size fish (PSD-P)and relative weight of stock length and greater (*Wr*≥S) Walleye from experimental gill net surveys in Angostura Reservoir, Fall River County, South Dakota 2006-2012. 80% confidence intervals in parentheses.

Year	N	CPUE	CPUE-S	PSD	PSD-P	*Wr*≥S
2006	98	24.5 (6.8)	23.3 (6.0)	27 (8)	3 (3)	82.8 (0.1)
2007	82	20.5 (4.0)	20.5 (4.0)	23 (8)	5 (4)	83.3 (0.7)
2008	123	41.0 (10.9)	39.0 (10.9)	65 (7)	2 (2)	84.7 (0.1)
2009	88	22.0 (2.3)	21.8 (2.4)	53 (9)	8 (5)	86.0 (0.7)
2010	94	23.5 (6.1)	21.5 (4.8)	53 (9)	6 (4)	83.3 (0.4)
2011	71	17.8 (7.0)	16.5 (6.4)	70 (10)	9 (6)	84.8 (0.2)
2012	86	21.5 (9.1)	20.0 (8.1)	48 (10)	6 (5)	87.7 (0.8)

Table 8. Estimated age, minimum, maximum and weighted mean length (mm) at capture for Walleye by otoliths from the Angostura Reservoir gill net sample, August 22-24, 2012.

Age	Minimum length range @ capture	Weighted mean length @ capture	Maximum length range @ capture	N
1	233	276	333	39
2	323	384	422	35
3	439	473	487	5
4	462	498	555	7
5	525	525	525	1
6	482	508	560	3
7	519	519	519	1
11	723	723	723	1

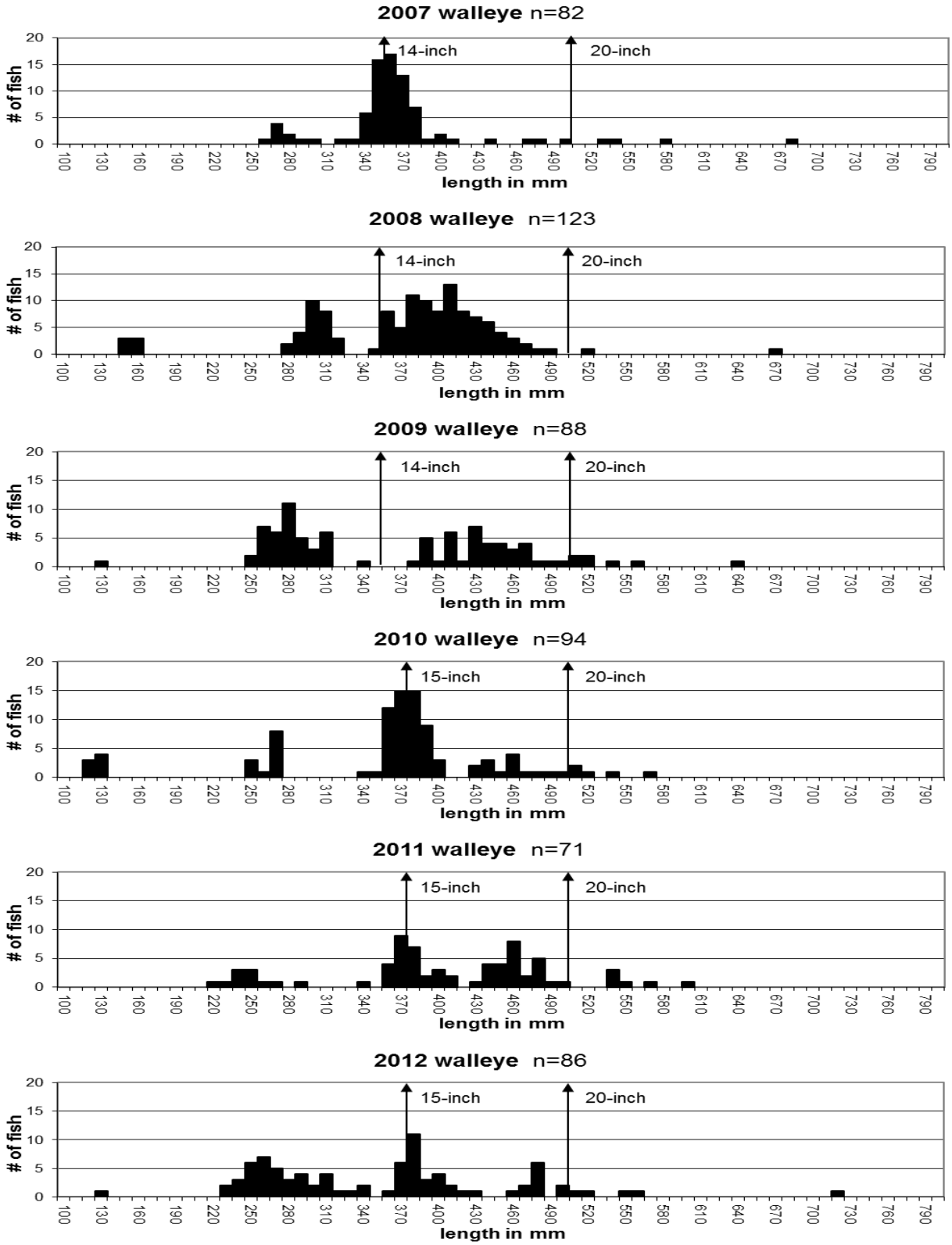

Figure 6. Length frequency histogram of Walleye collected in experimental gill nets from Angostura Reservoir, Fall River County, South Dakota, 2007-2012.

RECOMMENDATIONS

1. Continue conducting annual lake surveys to evaluate fish populations and regulation success.

2. Stock 100 to 200 pre-spawn adult Gizzard Shad the following spring if no adult or few age-0 shad are found during sampling.

APPENDICES

Appendix A. Stocking history, including year, number stocked, species and size of fish for Angostura Reservoir, Fall River County, South Dakota, 2000-2012.

Year	Number	Species	Size
2000	97,133	Rainbow Trout	Fingerling
	207,779	Walleye	Fingerling
2001	12,638	Largemouth Bass	Fingerling
	37,000	Rainbow Trout	Fingerling
2002	50,100	Walleye	Fingerling
	30,000	Smallmouth bass	Fingerling
2003	218,791	Walleye	Fingerling
	80,000	Rainbow trout	Fingerling
2005	381,045	Walleye	Fingerling
2008	479,900	Walleye	Fingerling
2010	289,340	Walleye	Fingerling
2011	310,199	Walleye	Fingerling
2012	476,423	Walleye	Fingerling

Appendix B. A brief explanation of catch per unit effort (CPUE), proportional stock densities (PSD, PSD-P) and relative weight (Wr):

Catch Per Unit Effort (CPUE) is the catch of animals in numbers or weight over a defined period of effort. Refers to trap-net nights or gill-net nights of effort, or catch per hour of electrofishing.

Stock density indices (i.e. **PSD, PSD-P**) provide proportional values for size structure of adult fish (Table 1). For example, PSD is the proportion of adult fish (i.e. fish ≥ a given stock length) within the population that are considered to be of quality size to anglers. PSD and PSD-P are unitless and usually calculated to the nearest whole digit. Below are calculations for these indices.

Proportional Stock Density (PSD) is calculated by the following formula:

$$PSD = \frac{\text{Number of fish} > \text{quality length}}{\text{Number of fish} > \text{stock length}} \times 100$$

Proportional Stock Density of preferred-length fish (PSD-P) is calculated as:

$$PSD\text{-}P = \frac{\text{Number of fish} > \text{preferred length}}{\text{Number of fish} > \text{stock length}} \times 100$$

Table 1. Size categories for selected species found in western South Dakota lake surveys, in centimeters (inches in parenthesis)

Species	Stock	Quality	Preferred	Memorable	Trophy
Black bullhead	15 (6)	23 (9)	30 (12)	38 (15)	46 (18)
Black crappie	13 (5)	20 (8)	25 (10)	30 (12)	38 (15)
Bluegill	8 (3)	15 (6)	20 (8)	25 (10)	30 (12)
Brown trout (lentic)	20 (8)	30 (12)	40 (16)	50 (20)	60 (24)
Channel catfish	28 (11)	41 (16)	61 (24)	71 (28)	91 (36)
Common carp	28 (11)	41 (16)	53 (21)	66 (26)	84 (33)
Green sunfish	8 (3)	15 (6)	20 (8)	25 (10)	30 (12)
Lake trout	30 (12)	50 (20)	65 (26)	80 (31)	100 (39)
Largemouth bass	20 (8)	30 (12)	38 (15)	51 (20)	63 (25)
Northern pike	35 (14)	53 (21)	71 (28)	86 (34)	112 (44)
Rainbow trout	25 (10)	40 (16)	50 (20)	65 (26)	80 (31)
Smallmouth bass	18 (7)	28 (11)	35 (14)	43 (17)	51 (20)
Walleye	25 (10)	38 (15)	51 (20)	63 (25)	76 (30)
White crappie	13 (5)	20 (8)	25 (10)	30 (12)	38 (15)
Yellow perch	13 (5)	20 (8)	25 (10)	30 (12)	38 (15)

For most fish species, PSD values of 30-60 or 40-70 are typical objective ranges for “balanced” populations. Values less than the objective range indicate a population dominated by small fish while values greater than the objective range indicate a population comprised mainly of large fish.

Relative weight (Wr) is an index that quantifies fish condition (i.e. how much does a fish weigh for its length). A Wr range of 90-100 is a typical objective for most fish species. Mean Wr values below 90 for a species or size group indicates problems may exist in food and feeding relationships. When mean Wr values are well above 100 for a size group, fish populations may not be making the best use of available prey.